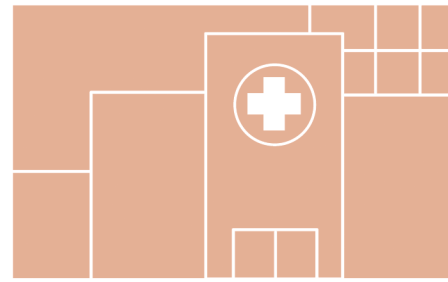
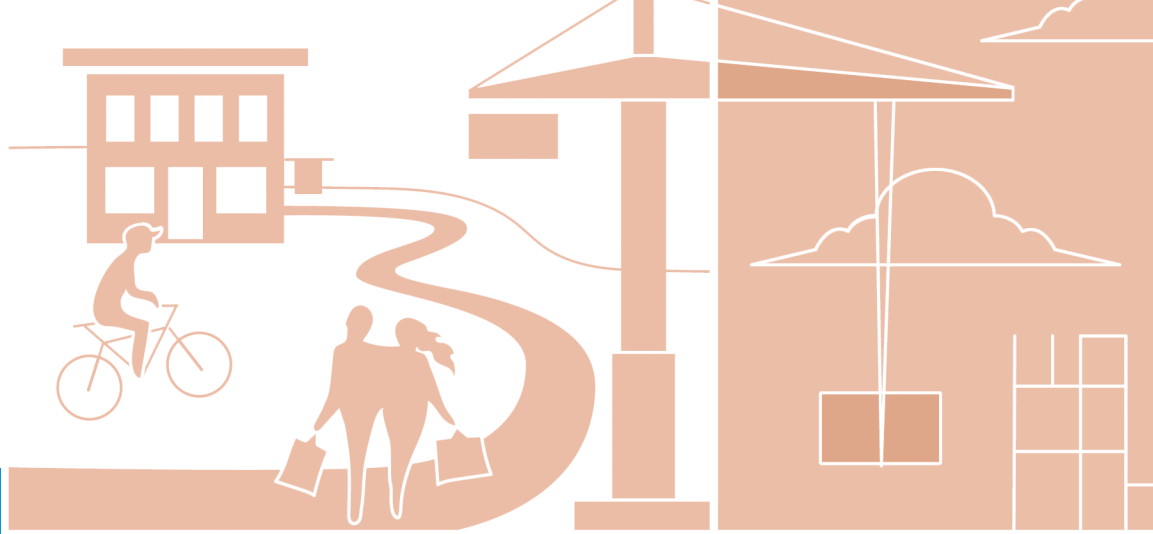




## REGIONAL FORECAST OF JOBS, POPULATION AND HOUSING



# Plan Bay Area 2040

FINAL  
SUPPLEMENTAL  
REPORT



JULY 2017

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# Plan Bay Area 2040: Final Regional Forecast of Jobs, Population and Housing

July 2017



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## Introduction: Regional Forecast Overview

To better understand growth dynamics in the nine-county Bay Area region, the Association of Bay Area Governments (ABAG) tracks and projects the region's demographic and economic trends. The regional forecast is an important component of the *Plan Bay Area*, the Bay Area Sustainable Communities Strategy (SCS), and provides a set of common regional assumptions informing the discussion among regional and local jurisdictions and organizations of how the region might grow. The forecast describes changes in employment, population, households and income distribution over three decades for the region, focusing on long-term trends, rather than cyclical variations. The regional forecast also serves as the control totals for the scenario analysis in which the estimated increment of growth is econometrically distributed to jurisdictions and smaller geographic areas within the region according to a set of policy assumptions. This background report focuses on the projections developed at the regional level, while the geographic growth allocation within the region is treated in a separate report.

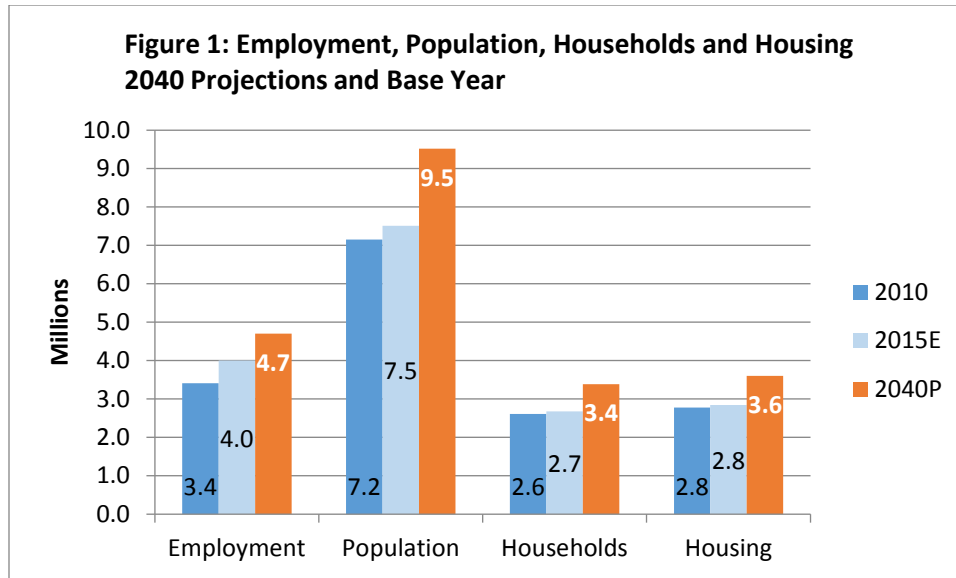
The regional forecast (or set of projections) shows that between 2010 and 2040, the Bay Area is projected to grow from 3.4 to 4.7 million jobs, while the population is projected to grow from 7.2 to 9.5 million people. This population will live in almost 3.6 million households, an increase of nearly 800,000 households over 2010 levels (see Figure 1). Recent data allows us to observe the actual experience in the first five years of this thirty year set of projections. Although as mentioned above, the regional forecast focuses on long-term trends, tracking progress to date highlights the range of variation that can occur within a long-term period and among the different elements projected. The cyclical nature of employment growth, through booms and busts, is evident, as is the more gradual pace at which population changes, as well as the lags that may affect housing expansion.

The forecast estimates:

- An increase of 1.3 million jobs between 2010 and 2040. Almost half of those jobs—over 600,000—were added between 2010 and 2015.
- An increase of 2.3 million people between 2010 and 2040. Almost one fourth of the projected growth occurred between 2010 and 2015.
- An increase of 783,000 households. Only 13 percent of that increase occurred between 2010 and 2015, but the pace of household growth will increase as an older population typically means smaller average household sizes.
- 823,000 additional housing units. Only 8 percent of this growth had occurred by 2015, highlighting the need for a focused effort to expand housing production to meet the needs of our broad range of household types. Of the 823,000 projected units, about 39,600 come from the increment of units added to the Regional Housing Control Total to meet the legal settlement agreement. (See In-Commute Estimates Section in the next chapter and in the Appendix)

Employment projections suggest an economy increasingly concentrated in professional services and health and education and less in direct production of goods and wholesale trading, in line with changes expected nationwide. Income-wise, while there is growth of households in all four income quartiles, it is in the bottom and top categories we expect to see relatively more growth. By 2040, the top and bottom categories are expected to comprise 56 percent of households, up from 51 percent in 2010. The population will become older and more racially, ethnically and economically diverse, thus influencing household characteristics and location choices.





Source: ABAG from California Department of Finance, California Employment Development Department, U.S. Bureau of the Census, and in-house analysis

Table 1 shows the numbers associated with this summary.

	2010	2015	2040	Change 2010-40	Change 2015-40	2010-2040%	2015-2040%
<b>Total Employment<sup>[1]</sup></b>	3,410.9	4,025.6	4,698.4	1,275.6	672.8	37.7%	16.7%
<b>Population<sup>[2]</sup></b>	7,150.7	7,609.0	9,522.3	2,371.6	1,913.3	33.2%	25.1%
<b>Households<sup>[3]</sup></b>	2606.3	2,699.3	3,388.6	782.8	689.8	30.0%	25.6%
<b>Regional Housing Control Total<sup>[4]</sup></b>	2784.0	2,839.6	3,606.6	822.6	765.0	29.5%	27.0%

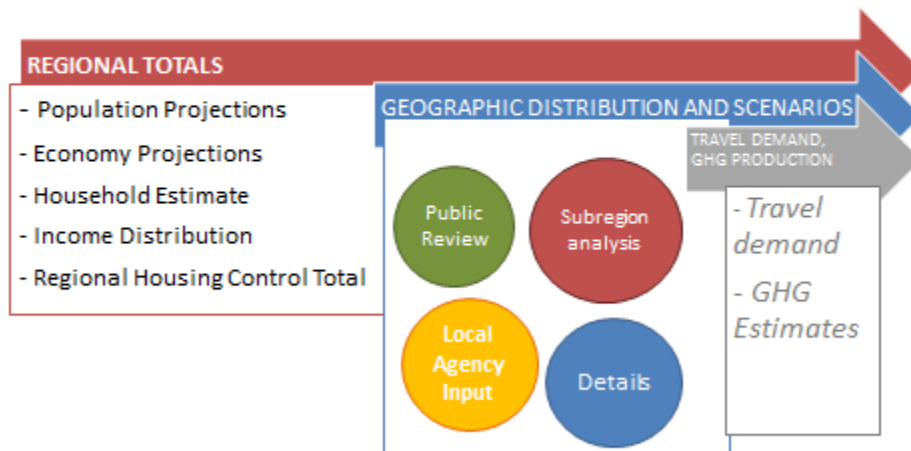
Source: California Department of Finance (DOF) and Employment Development Department [2010], ABAG analysis.  
 [1] 2015 is ABAG year to date estimates based on 10-month growth rates estimated from EDD data. [2] 2015 is July 2015 estimate from the DOF; [3] 2015 is ABAG estimate for mid-year, based on 2015 January data and growth estimates; [4] 2015 is DOF estimate for January 2015; later years are calculated as the household number divided by 0.95 to account for 5 percent vacancy plus the in-commute increment (added in proportionately from 2020 to 2040).

# Chapter 1: Regional Forecast Approach

## A Multiagency Effort

The forecast for *Plan Bay Area* is a cooperative effort between the ABAG research program, the Metropolitan Transportation Commission (MTC) modeling team, and local jurisdiction planning staff. ABAG develops regional totals for population, households, employment, output, and income. Geographic distribution of the forecast within the region is accomplished through efforts of ABAG and MTC modeling and planning staff with input at several stages from local jurisdictions. MTC then uses the information from the geographic distribution of the forecast for detailed travel demand analysis and estimates of greenhouse gas production. See Figure 2.

Figure 2  
*Plan Bay Area 2040 Regional Forecasting Process*

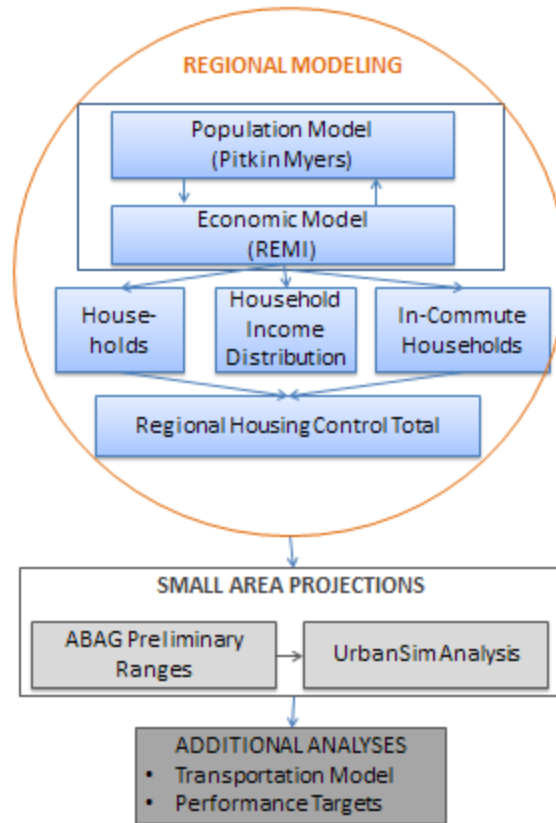


This report, *Regional Forecast of Jobs, Population and Housing*, gives a brief overview of the entire process and describes the major elements of the first rectangle in Figure 1, the population, economic, household, income distribution, and regional housing control totals, including method of approach and results accepted by the ABAG Executive Board in January 2016. The *Land Use Modeling Report* describes the process and results of small area projections at the local jurisdiction and traffic analysis zone (TAZ) level. The *Travel Modeling Report* describes the application of the output from the Land Use Model to produce estimates of vehicle miles traveled and transit use. The *Performance Report* describes the results of these projections for greenhouse gas production as well as for the other performance targets developed for the plan.

## Technical Components of Regional Projections

ABAG uses a suite of customized and in-house models to project economic activity, population growth and composition, household growth, income distribution, and the regional housing control total. These are schematically diagrammed in Figure 3.

Figure 3  
Components of the Regional Modeling Process



The Pitkin-Myers model for the Bay Area produced an initial range of population projections based on different levels of in-migration to the region and a benchmark for comparison of the demographic composition of the population. The ABAG Economic-Demographic Model is built on the structure of a Regional Economic Modeling Inc. (REMI) regional model, with adjustments to reflect characteristics of the Bay Area economy and expectations for sectoral change at the national level through 2040. The ABAG-REMI model produces projections of employment, gross regional product and labor force. (See appendix on how the raw REMI output is translated into employment and employed resident levels for use by the small area analysis and land use and transportation models). ABAG also used this model to produce the final population projection, after verification with the earlier population analysis, to maintain consistency between the population, employment, output and total personal income estimates.

The household, income distribution, in-commuting and regional housing control total estimates are each built around the projections from the ABAG-REMI analysis. Household projections are generated through a headship rate analysis. The household module uses the projected age and ethnic distribution of the adult population and a moving average of the percent in different age categories that are heads of household to project the number of households associated with demographic characteristics and size of the population.

The household income distribution analysis estimates the share of households in each of four mutually exclusive income groups, to coincide with analysis required in the transportation model. The share of

households in low, middle-low, middle-high and high income categories is estimated using a regression analysis which ties the share in each wage category with ethnic and age distribution, industry characteristics, relative housing prices, and per capita income.

In-commuting is estimated through two different methods, based on the ABAG-REMI output. The regional housing control total combines information from the household projections module and the in-commuting assessment to produce an estimate of total housing units needed for the region. The housing stock is assumed to allow a 5 percent vacancy, while providing housing units for the projected households plus for the number of households that would be associated with any increase in in-commuting.

ABAG staff consulted with a technical advisory committee in the initial stages of model design and before selection of the first draft forecast, with experts on the structure of the models (John Pitkin, Dowell Myers, and REMI staff), and with Stephen Levy of the Center for Continuing Study of the California Economy in developing the regional projections. Staff also presented the projections process in workshop and conference settings. A more detailed description of the technical elements of the models and analytic modules and a list of technical advisory committee members is provided in the appendix.

## Approach to Other Aspects of the Forecast

Projections at the jurisdiction and small area level (shown in Figure 3 in the light grey box below the main model elements) involved modeling, evaluation and engagement. ABAG and MTC staff worked with stakeholders to define a set of distinctive scenarios exploring different growth distribution concepts within the region, as described in a memorandum to the Joint MTC Planning Committee with the ABAG Administrative Committee.<sup>1</sup> These scenarios became the basis for the development of target ranges for jurisdictions. These target ranges were compared with planning documents and shared with planning staff of jurisdictions. In addition, to capture the rapid growth occurring in the first five years of the projection period (2010-15), each jurisdiction was asked to provide information on recent and pipeline development projects.

The UrbanSim Model (described in detail in the *Land Use Modeling Supplemental Report*) incorporated the detailed information gathered on the jurisdictions and translated scenario concepts into assumptions regarding future policies, tied to the intentions of different scenarios. Results of the model runs were reviewed by ABAG regional planners and by local jurisdictions, but were not manually post-processed for any reason. The local projection represents a model view of the Bay Area's land use future, and can help inform policy discussions and gap analyses relative to performance measures. The results of the local projection by county, city, unincorporated areas, and priority development areas are shown in the [Land Use Modeling Report](#).

One such component is the modeling of the performance of the transportation system for the region (shown in the dark grey box at the bottom of Figure 3). The data on the future sub-regional distribution of households and employment is used to model transport demand. Information on land use and

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<sup>1</sup> See the memo at <https://mtc.legistar.com/View.ashx?M=F&ID=4125614&GUID=6DEA539A-8798-4221-A315-A2EC61692027>

investment alternatives given those patterns provide information on a range of indicators of interest, including travel times, delays and greenhouse gas emissions.

## Overall Assumptions

Conducting a forecast is not merely a matter of crafting the best models. The work requires speculation about what might change in the future and how it would change. For example, an economic forecasting model may embed assumptions about the pace of technological change and the effects on different industrial sectors. Changing birth rates in a demographic model may reflect a changing ethnic mix but may also assume broader social changes that affect births across cultural groups. Household formation and income levels may be affected by broad social changes in labor force participation and by structural changes in the organization of work that can affect job certainty, hours, and benefits. All of these changes have a wide range of uncertainty embedded in them. Some of the explicit decisions are touched on in the Appendix.

In general, in terms of economic structure, this forecast reflects some of forthcoming changes through the incorporation of increased productivity across all sectors in the economic model, which could account in part for automation and digitalization effects. At the US level, productivity overall rises by about 50 percent, with some sectors more than doubling (utilities, manufacturing, wholesale, information and management), additional sectors growing at above average rates (retail, transportation and warehousing, finance and forestry), and some experiencing much slower than average productivity gains (education and health care).

Household and income projections recognize some but certainly not all of the potential changes that may come about in the next decades. The changing ethnic mix is systematically incorporated by the structure of the household module. Changing formation rates by ethnic category are added for seniors, recognizing a convergence of gender differentiated survival rates among older populations. On the other hand, some potential major labor structural changes (a greatly expanded “gig” economy, for example) are not included explicitly in the forecast, as this may require some substantial analytic work before making model changes at all three levels (regional economic forecast, transportation model forecast, small area distribution)—on the to do list for consideration in the next cycle.

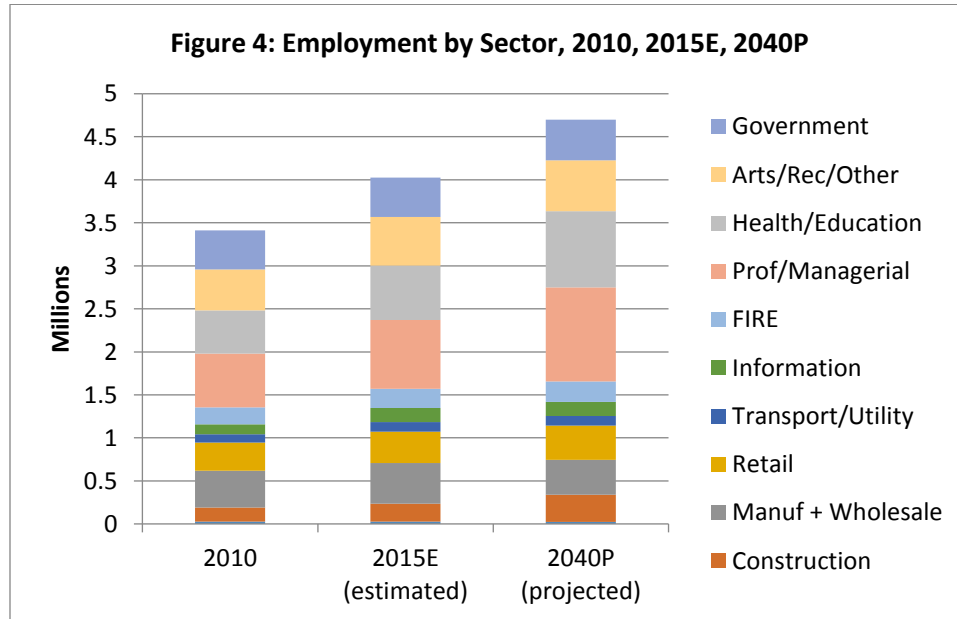
While models incorporate some potential changes, we must recognize that any assumptions are subject to great uncertainty and variation. Some variations may be offsetting (for example, declining retail jobs may be offset by increased employment in distribution facilities). The greatest amount of variation with respect to structural changes such as automation and social changes in family formation is likely to occur in the later years of the forecast, although sudden disruptions (as with the dot com boom and bust) are possible in any period.

## Chapter 2: Major Findings

By 2040, the San Francisco Bay Area is expected to see a net addition of 1.3 million jobs and 2.3 million people, leading to totals of 4.7 million jobs and 9.5 million residents. This level represents an increase of 37.7 percent for employment and 33.2 percent for population in the region. The slightly higher growth rate for employment is affected by the 2010 base year, when employment was at a low point due to the recession. Going forward, the projections imply more measured job growth for the balance of the projection time frame, as roughly half of the projected employment growth out to 2040 had already materialized as of 2015. While the pace of growth going forward may seem conservative, the average trend over the thirty-year period is robust. If the region reaches the upper end of an employment cycle by 2020 or earlier, then the long-term growth rate (as projected here) will be dampened by the downturn and recovery period. It is worth remembering that after the dot-com bust, it took nearly 15 years—until 2015—for the region to eclipse the previous employment peak. The population projection in turn takes into account the aging of the labor force and the associated need for replenishment from natural increase as well as migration, both domestic and international. Housing growth is somewhat dampened relative to 2010 because of the recession-induced higher vacancy rate (and therefore excess space) that existed in some parts of the region in 2010.

### Employment Growth and Change

Figure 4 compares the level and distribution of employment in 2010, 2015 and 2040 (projected). Table 2 shows 2010, 2015 and 2040 estimates of employment and employment change for aggregate Bay Area employment sectors.



Source: ABAG from U.S. Bureau of Labor Statistics, U.S. Bureau of the Census, American Community Survey, and modeling results from ABAG REMI 1.7.8, NC3RC1

As noted above, almost one half of the projected job growth from 2010 had already occurred as of 2015. The 2010 to 2015 strength reflects a combination of recovery from the depths of the 2007 to 2009 recession and a strong surge in economic activity related to the technology and social media sectors. In

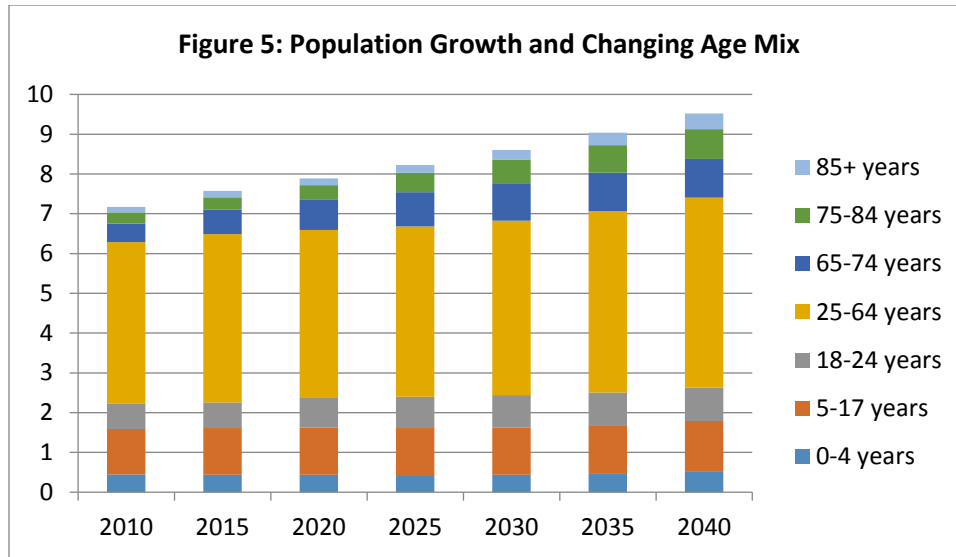
this projection, employment growth continues to slightly outpace the nation, with the Bay Area share of U.S. employment growing from 2.5 percent in 2010 to 2.69 percent in 2015 and to 2.76 percent in 2040. Despite increases in both output and demand in all sectors, we nonetheless project employment *declines* in a few sectors, due to both technologically induced higher productivity and changes in economic structure. As a result, the shares of employment in Professional and Managerial Services, Health and Educational Services, and Construction continue to grow substantially even after full recovery between 2010 and 2015, while the slower growing sectors and those losing employment will account for smaller shares of total employment. This continued shift to health and professional business occupations is consistent with expectations for population growth concentrated in retirement age and working age groups.

(Thousands)	Levels			Growth		Percent Change	
	2010	2015	2040	2010-2040	2015-2040	2010-2040	2015-2040
<b>Total Employment</b>	3,410.9	4,025.6	4,698.4	1,287.5	672.8	37.7%	16.7%
<i>Agriculture &amp; Nat Resources</i>	25.1	26.6	24.4	-0.7	-2.2	-2.9%	-8.4%
<i>Construction</i>	165.7	210.3	313.4	147.7	103.1	89.1%	49.0%
<i>Manufacturing &amp; Wholesale</i>	428.5	471.1	408.3	-20.2	-62.8	-4.7%	-13.3%
<i>Retail</i>	324.8	364.7	398.2	73.4	33.5	22.6%	9.2%
<i>Transportation &amp; Utilities</i>	97.1	112.2	110.5	13.4	-1.7	13.7%	-1.5%
<i>Information</i>	118.0	164.1	165.0	47.0	0.9	39.8%	0.5%
<i>Financial &amp; Leasing</i>	194.9	220.8	234.5	39.6	13.7	20.3%	6.2%
<i>Professional &amp; Managerial Services</i>	625.2	799.1	1,093.4	468.2	294.3	74.9%	36.8%
<i>Health, Educational Services</i>	502.7	634.7	887.6	384.9	252.9	76.6%	39.8%
<i>Arts, Recreation, Other Services</i>	476.5	562.5	591.8	115.3	29.3	24.2%	5.2%
<i>Government</i>	452.2	459.5	471.3	19.1	11.8	4.2%	2.6%

Source: ABAG forecast based on REMI version 1.7.8, model NC3RC1

## Population Growth and Change

While the 2040 population as a whole is projected to be 33 percent higher than in 2010, growth will differ widely by age group. (See Figure 5). The number of school-aged children (5 to 17 years old) is projected to grow by only 11.5 percent, while the number of people aged 65 and over will increase by 140 percent because of the baby boomer cohorts increasingly entering retirement in the coming years thus accounting for more than half of all growth in the region.

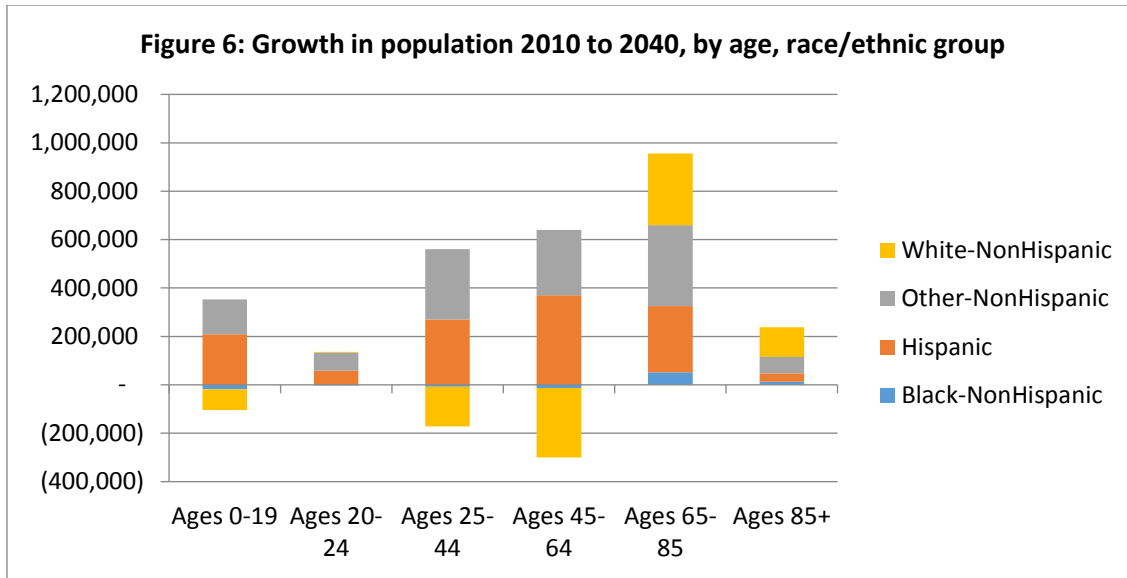


Source: ABAG compilation from U.S. Bureau of the Census and ABAG REMI 1.7.8, NC3RC1

Between 2015 and 2040, employment is projected to grow faster than the population in prime working years between 25 and 64 (16.7 percent compared to 12.9 percent). The difference will be made up by faster increase of younger workers compared to employment growth (“college-aged” workers, aged 18 to 24, increase by 29.7 percent in that period), by a portion of older workers remaining in the labor force, and possibly by a small increase in the count of workers in-commuting from outside the region. Age-wise, of the 2.3 million growth, 1.2 million is expected to be in senior age groups. A modest increase in the rate of labor force participation in this age category could contribute significantly to the available, experienced workforce.

Ethnically, the region continues to diversify over time, as shown in Figure 6. Growth takes place mainly in Hispanic and Asian racial/ethnic groups (the largest category within Other NonHispanic in the figure). There is a small growth of the Black non-Hispanic population, entirely within the senior age group. The senior non-Hispanic white category also increases, but the total non-Hispanic white population (across all age groups) decreases. In 2010, only among seniors 65 and older was there an ethnic category (White, Non-Hispanic) with more than half of the population. By 2040, there are no majority ethnic categories for any of the age groupings shown in the figure.

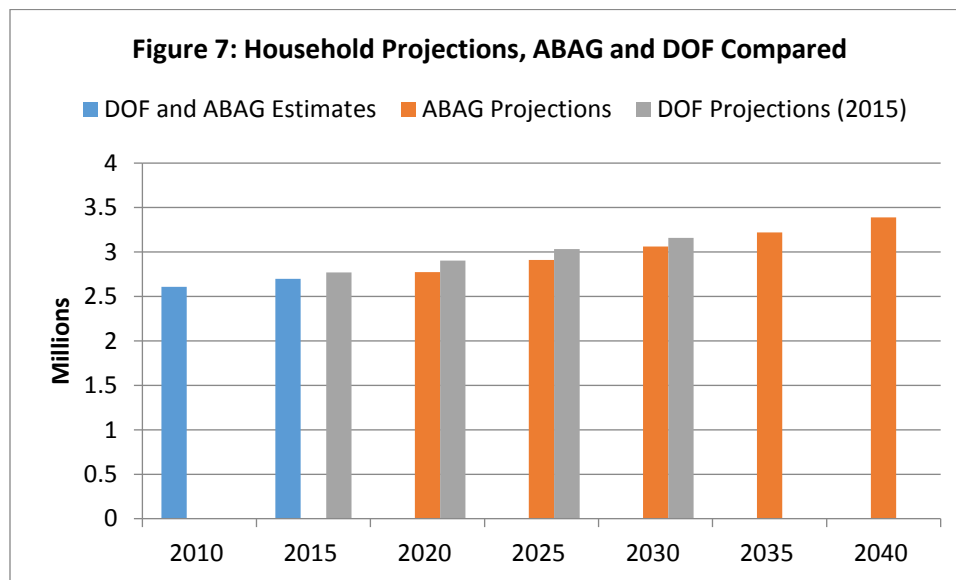




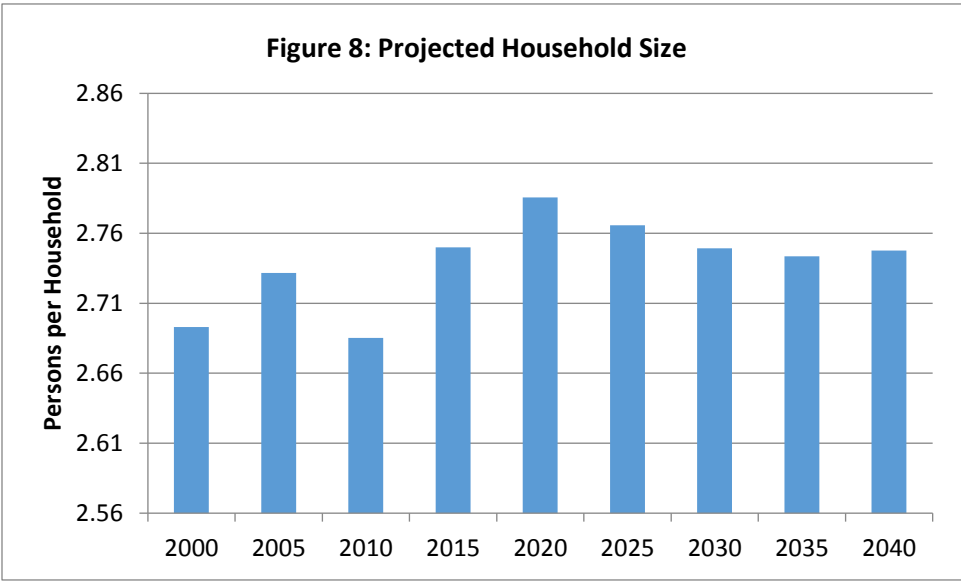
Source: ABAG analysis using Bay Area REMI 1.7.8 model, NC3RC1 results. Note that Other-NonHispanic includes Asian, Pacific Islander, and multiracial/multiethnic categories.

## Household Growth

The amount of household growth projected (Figure 7) assumes household size continues to be constrained by costs and is also affected by behavioral factors such as increases in the share of multigenerational households and a higher share of two-person senior households (due to improving survival rates for older men). In the short run, household size continues to increase, as it has since 2010, but as new construction also increases, household size drops back to just below 2015 levels. (See Figure 8).

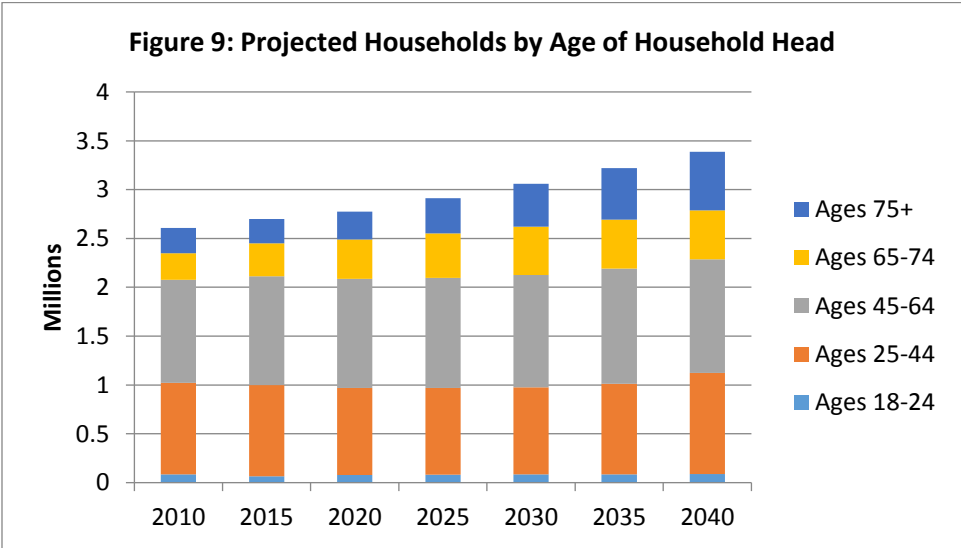


Source: ABAG housing model and estimates; California Department of Finance (DOF) Reports E-5 (May 2015) and P-4 (March 2015)



Source: ABAG REMI 1.7.8, NC3RC1, and California Department of Finance Report E-5, May 2015

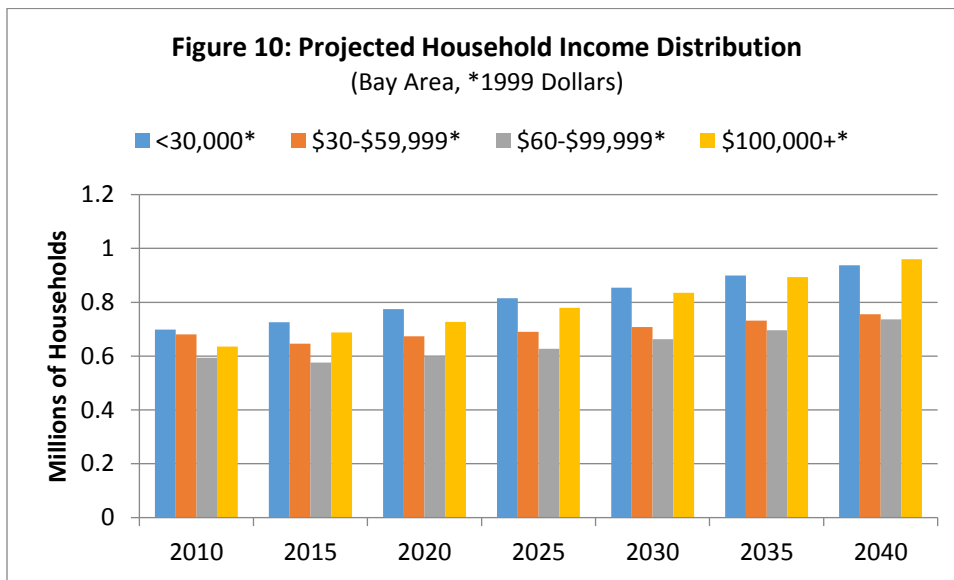
Characteristics of households are very much influenced by the changing age structure. As shown in Figure 9, households headed by people 65 and older account for the largest share of the increase from 2010 to 2040—some 568,000 households, or more than 70 percent of the 780,000 growth in households. Remaining household growth is divided between the 25 to 44-year-old age group and the 45 to 64-year-old age group. This may shift overall demand from suburban single family homes to multifamily developments or more urban settings where health care and other support services are readily available.



Source: ABAG housing model

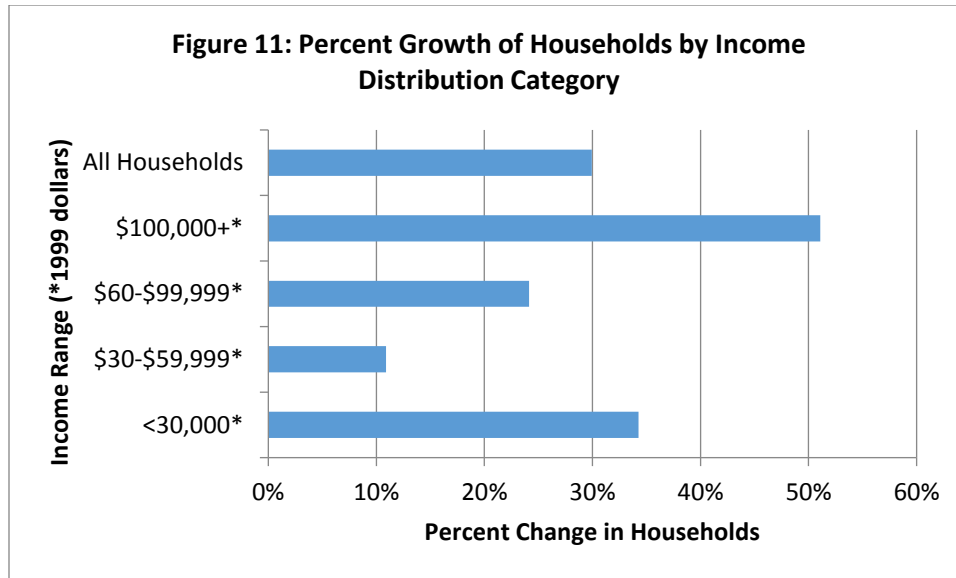
## Household Income Distribution

While all four household income groups, as defined by income categories, are expected to grow, it is the lowest and highest groups we expect to see relatively more households by 2040.<sup>2</sup> The “hollowing out” of the middle is projected to continue over the next 25 years, as shown in Figure 10. Household growth will be strongest in the highest income category, reflecting the expected strength of growth in high wage sectors combined with non-wage income (interest, dividends, capital gains, transfers). Household growth will also be high in the lowest wage category, reflecting occupational shifts, wage stagnation, as well as the retirement of seniors without pension assets. Slowest growth will be in the lower middle category, highlighting concerns about advancement opportunities for lower wage workers. (See Figure 11).



Source: ABAG household income distribution analysis.

<sup>2</sup> The income categories were originally defined as approximate quartiles, but remained defined by income levels adjusted to 1999 dollars to be consistent with the requirements of the transportation model. The income categories, in 1999 dollars, are less than \$30,000; from \$30,000 to \$59,999; from \$60,000 to \$99,999; and \$100,000 and above.



Source: ABAG income distribution analysis. Note: Categories compared were in 1999 dollars for all years.

## In-Commute Estimates

Our estimate of net commuting between Bay Area counties and other areas shows that net in-commuting would be expected to grow by up to 53,000 between 2010 and 2040. The greater amount of this increase may have already occurred over the past 5 years.

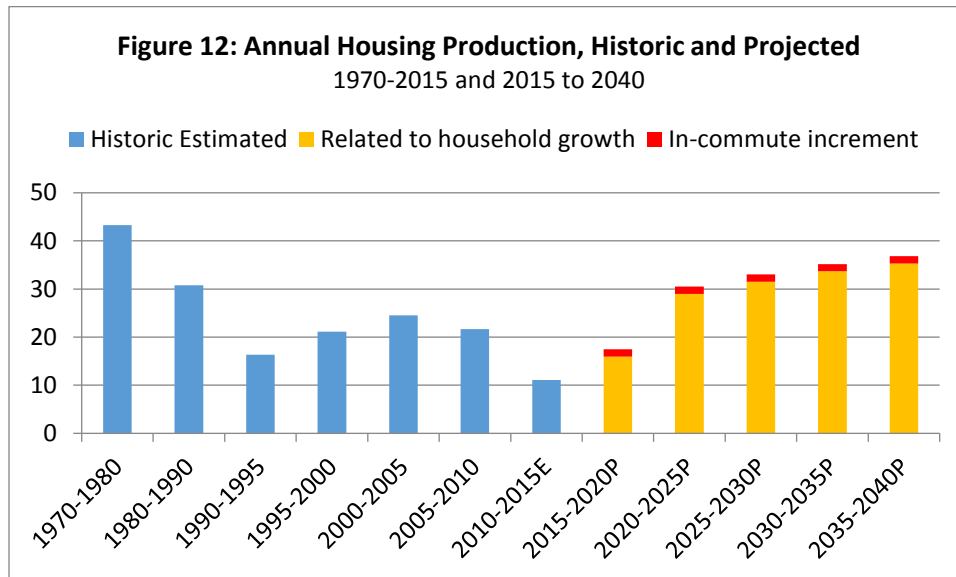
Using a ratio of approximately 1.41 workers per household, we include an estimated additional 37,600 households related to the in-commute change leading to an additional 39,600 housing units (at 5 percent vacancy) in calculating the Regional Housing Control Total, to fulfill the requirements of the legal settlement of ABAG and MTC with the Building Industry Association Bay Area.

## Housing Production

To translate growth in households to the anticipated demand for housing units, ABAG assumes a 5 percent vacancy rate for the region.<sup>3</sup> The projected increase of 822,600 new housing units includes 39,600 units associated with the growth in the projected number of in-commuters between 2010 and 2040. The Regional Housing Control Total of 3.607 million housing units includes units for all projected households plus the much smaller number of units associated with the in-commute. From the January 2015 base provided by the California Department of Finance, this implies an annual average rate of increase of between 17,000 and 37,000 units, depending on the time period (the level of demand for new housing units increases over the projection time period, as shown in Figure 12), and assuming the in-commute related increment of housing is added gradually over the full 25-year period. The great majority of the new housing units projected would be to fill the needs of projected household growth

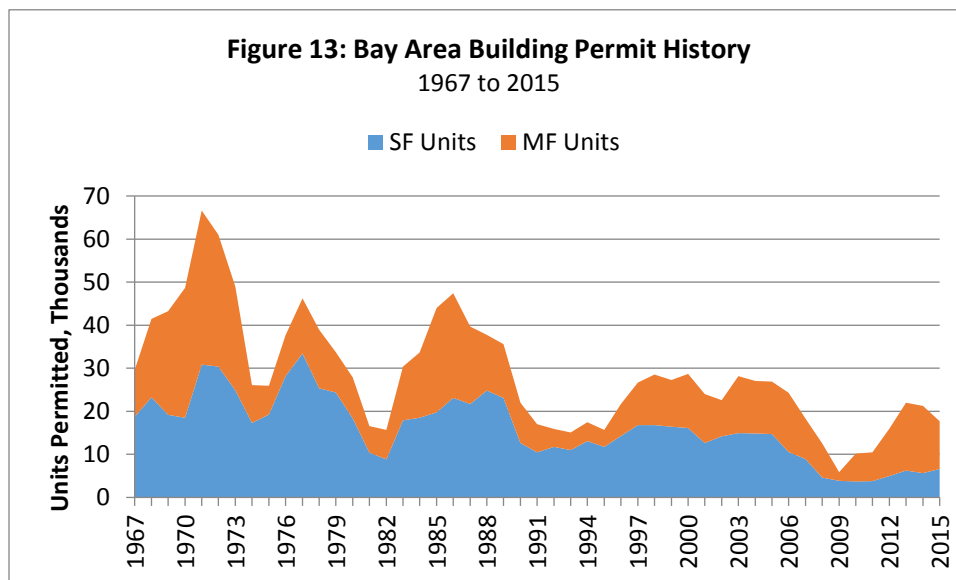
<sup>3</sup> California Department of Finance estimates of Bay Area vacancies have varied from 3.4-6.4 percent since 2000.

within the region. The portion of the projected bars shown in red is the added increment related to the projected growth of in-commuting.



Source: U.S. Bureau of the Census, California Department of Finance, and ABAG analysis

The housing unit growth projected through 2040 would require a major jump in production beginning in 2020, returning to levels of sustained production not seen since the 1980s. In addition, because of changing demographics and requirements to reduce greenhouse gas production, we can expect multifamily to be at least as large a share of this as was the case in most of the 1980s, and possibly close to the share experienced in recent years (see Figure 13).



Source: Compiled by ABAG from Construction Industry Research Board and California Housing Foundation data.

Note: 2015 permits are through November only

## Chapter 3: Projections Compared to Alternative Forecasts

There is no “right” forecast, given the level of uncertainties in the future about economic trends, innovation and entrepreneurialism, technological change, demographic characteristics and behavioral changes. A credible forecast needs to take account of two broad considerations. The projections need to be built on a realistic assessment of the national outlook and regional competitiveness relative to the nation (a “top down” economy requirement), but at the same time are expected to reflect the cumulative effects of local land use policies (a “bottom up” land use requirement), as well as the conditions aspired to by the regional plan and state policy.

A “business as usual” set of projections based on existing patterns of housing development would likely be driven by a continuing increase in housing prices, a tightening of vacancies, and an increase in household size, with a consequent redistribution of a portion of economic activity outside of the region as well as increasing in-commuting into the region. ABAG has for more than a decade produced “policy-based” projections. The current set of projections is expected to move beyond current land use policies to reflect the requirements and spirit of SB375 to reduce greenhouse gas emissions and also to anticipate housing commensurate with the growth in the economy. At the same time, recognizing that growth is a complex process, the projection used for future regional planning must still be anchored in realistic expectations so that the numbers produced are useful for planning long-term investments in transportation and other infrastructure. Depending on how much emphasis is placed on the constraints versus opportunities in the economy and assumptions regarding infrastructure and institutional capacity, different groups come up with different projections. There are lower population projections that have been released by credible groups, as there are higher employment projections also released by different credible groups.

### Compared to Lower Projections

ABAG retained John Pitkin and Dowell Myers, nationally renowned demographic experts, to provide regional projections for the Bay Area out to 2040. Pitkin-Myers provided a base projection, as well as the model code allowing ABAG staff to adjust key components, like migration assumptions. The *Plan Bay Area 2040* population projection is higher than the baseline version of the Pitkin-Myers Bay Area projections and higher than the California Department of Finance (DOF) 2040 projection from 2015. The Pitkin-Myers base projection (8.95 million in 2040) assumes that migration continues as it did in 2000 to 2010, a period of high net domestic out-migration. This pattern of migration has *not* continued in the past five years. A version of the Pitkin-Myers projection assuming a migration pattern similar to an average over earlier decades (a 15 percent increase in in-migration over 2000 to 2010 levels compared to the base) instead gives a population level of 9.49 million in 2040, much closer to the ABAG update. For comparison, the DOF population projection completed in 2015 does not reach 9.5 million people until 2045. (However, the DOF household projection from March 2015, which goes only through 2030, is conversely slightly *higher* than the ABAG final household projection through 2030, because of different assumptions on changes over time in household headship rates. Those who prefer the lower DOF projections would also be faced, for consistency, with higher household projections.)

### Compared to Higher Projections

The updated employment projection is lower than the Center for Continuing Study of the California Economy (CCSCE) projection released December 2015. At the level of total employment, the major

difference is a slower rate of growth between 2015 and 2020 in the ABAG projection as compared to CCSCE December 2015. This reflects a difference in interpretation of the observed 2010 to 2015 surge, which was triggered mainly by growth in the information, professional and business services and construction sectors. ABAG interprets the surge as driven by general cyclical and product cycle forces more so than a long-term structural adjustment. Its effect on the long-term base of growth would be modest, consistent with the pattern of highly volatile expansions and contractions during the past few decades, with strong build-up in employment during upswings followed by substantial losses during downturns. (Because a correction is likely by 2020, the projection shows little growth between 2015 and 2020). Treating the recent job surge as growth in the *long-term* employment 2015 base could raise the 2040 employment by between 150,000 and 300,000 jobs, depending on other assumptions. To get the labor force commensurate with such job demand would entail either a population of over 10 million by 2040 or much higher in-commute levels (or both).

## Disruptors and Uncertainties

In addition to the variations in assumptions discussed above, there are other much larger changes that could have significant effects on employment and income levels sometime within the projection period. To some degree, these changes are taken into account in the national forecast on which this projection is driven. However, neither the national forecast, adjusted by ABAG, nor the regional employment estimates fully incorporate changes around which a great deal of uncertainty exists. Automation, for example, has steadily eroded employment in some sectors, such as manufacturing, and in some occupations, such as drafting technicians, while digital communications and web-based transactions have changed the viability of major players in the retail industry and reduced demand for occupations such as travel agents. Further innovations could spread these effects to other sectors and occupations, yet both of these changes also have been accompanied by expansions of employment opportunities in other parts of the economy. Moreover, social and political changes may affect how jobs are defined and structured, the spaces where work takes place, and the timing of work. These possibilities should be considered as detailed planning occurs for specific projects but are too uncertain in their effects to be incorporated into these forecasts. Long term changes in occupations and the structure of work will be addressed further in the implementation of the *Plan Bay Area* action items related to economic development.

## Finding a Middle Ground

ABAG projects higher population and employment growth levels than would occur were housing production to continue at the very slow pace of 2008 through 2012 or even the quickening pace of 2013-2015. In that sense, it is an optimistic projection assuming local and regional policies will lead to greater housing production and a housing market that serves the needs of a wider range of residents than is currently the case. While the region has seen a strong job growth after the Great Recession, with job levels more than 20 percent higher than at the end of the recession in 2009, the population over the same period has grown just four percent. The much faster growth of jobs compared to housing expansion has been possible through lowering of the unemployment rate and an increase in the labor force participation rate, tightening the recession-era slack in the labor market. Going forward, for the projected level of employment growth to occur, with the slack already “used,” the rate of housing production will need to meet and eventually exceed that experienced in the 1980s.

The data presented in this report describe projections at the regional level. Distribution of the forecast geographically depends in part on market factors and in part on local and regional policy, including decisions regarding transportation investments. As different scenarios were explored for local policy and regional transportation investments, patterns emerged on where growth may concentrate or disperse, and the type of jobs and housing that may locate in different parts of the region. The regional data presented here underlay each of the scenarios analyzed in the course of reaching the preferred scenario. The land use analysis is described in the *Land Use Modeling Report*.



## Acknowledgments

We would like to thank the following:

Members of the Regional Forecast Technical Advisory Committee who between September 2014 and May 2015 met with ABAG staff, responded to numerous questions, reviewed drafts and provided insight on alternative projections, including

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Clint Daniels, Principal Analyst, San Diego Association of Governments (SANDAG)

Ted Egan, Chief Economist, Controller's Office of Economic Analysis, City of San Francisco

Robert Eyler, Professor of Economics and Director, Center for Regional Economic Analysis, Sonoma State University

Gordon Garry, Director of Research and Analysis, Sacramento Area Council of Governments

Tracy Grose, Bay Area Council Economic Institute

Subhro Guhathakurta, Professor, Georgia Tech University, Department of City and Regional Planning

Hans Johnson, Senior Fellow, Public Policy Institute of California

Jed Kolko (Economist, jedkolko.com; former Chief Economist, Trulia)

Walter Schwarm, Demographic Research Unit, California Department of Finance

Michael Teitz, University of California Berkeley and Public Policy Institute of California, Retired

Daniel Van Dyke, Rosen Consulting Group

Ex-officio Technical Advisory Committee members

Sean Randolph, Bay Area Council Economic Institute

David Ory, Metropolitan Transportation Commission

Michael Reilly, Metropolitan Transportation Commission

Stephen Levy, Center for Continuing Study of the California Economy, provided extensive assistance and feedback in using the REMI tool to examine alternative forecasts.

Chris Brown and many other staff from REMI worked extensively with us to develop a model that reflected the unique characteristics of the Bay Area economy, while helping us to maintain the integrity of the REMI model.

## Appendix: Summary of Technical Approach Underlying ABAG Final Regional Forecast 2010-2040

This Appendix summarizes the methods used to calculate the regional forecast released January 19, 2016,<sup>4</sup> and describes the methods underlying:

- Employment projections
- Population projections
- Household projections (number and income distribution)
- In-commute projection
- Regional Housing Control Total projection

### Employment

ABAG built the employment projection using the Bay Area REMI PI+ model<sup>5</sup>, version 1.7.8, with the adjustments described here. Regional Economic Modeling, Inc. (REMI) for more than 25 years has produced custom regional models for use in making projections and for impact analysis. We made several adjustments to the “out-of-the-box” model at both the national and local level.

Adjustments include:

- 1) Modifying the rate of employment growth at the *national* level for construction, information, retail, wholesale and transportation and warehousing sectors.
- 2) At the *regional* level, modifying residential and nonresidential investment and the relative housing price, and replacing the first two years of forecast employment with estimates based on reported Bureau of Labor Statistics employment growth rates.
- 3) At the *regional* level, translating employment results from the U.S. Bureau of Economic Analysis (BEA) employment definition to a measure equivalent to the U.S. Bureau of Labor Statistics (BLS) measure of jobs by place of work plus the U.S. Bureau of the Census measure of self-employed workers.

### Adjustments to National Control

Table A-1 compares the REMI out-of-the-box National Standard Control (NSC) employment results with the modified national control (we have identified this version by the code NC3).

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<sup>4</sup> For a comparison to the methodology in ABAG’s preliminary forecast, see “Summary of Technical Approach Underlying ABAG Final Regional Forecast 2010-2040,” Attachment A to “Final Regional Forecast 2010-2040” Memo to the Executive Board, January 19, 2016.

<sup>5</sup> See Regional Economic Models, Inc., *Bay Area Economic Forecasting: PI+/HD and County Control Forecasting*, March 2014. Further documentation available on model updates at <http://www.remi.com/resources/documentation>.

<b>Category</b>	<b>2010</b>	<b>NSC 2040</b>	<b>NC3 2040</b>	<b>Difference</b>
<b>Forestry, Fishing, and Related Activities</b>	855.4	699.3	699.3	0
<b>Mining</b>	1268	2126.9	2126.9	0
<b>Utilities</b>	582.2	350.1	350.1	0
<b>Construction</b>	8793.7	18206.6	17397.6	-809.0
<b>Manufacturing</b>	12102.9	10382.5	10382.5	0
<b>Wholesale Trade</b>	6024	6343.7	7032.2	688.5
<b>Retail Trade</b>	17591.6	18428.9	20619.1	2190.2
<b>Transportation and Warehousing</b>	5474.2	5955.8	6410.2	454.4
<b>Information</b>	3222.6	2450.0	3200.3	750.3
<b>Finance and Insurance</b>	9202.4	10328.4	10328.4	0
<b>Real Estate and Rental and Leasing</b>	7697	9107.2	9107.2	0
<b>Professional, Scientific, and Technical Services</b>	11755.8	18847.4	18847.4	0
<b>Management of Companies and Enterprises</b>	2019.4	1835.0	1835.0	0
<b>Administrative and Waste Management Services</b>	10402.2	15367.1	15367.1	0
<b>Educational Services</b>	4089.9	5027.7	5027.7	0
<b>Health Care and Social Assistance</b>	19089.9	31162.8	31162.8	0
<b>Arts, Entertainment, and Recreation</b>	3788.4	4569.8	4569.8	0
<b>Accommodation and Food Services</b>	11986.3	14608.8	14608.8	0
<b>Other Services, except Public Administration</b>	9780.8	10396.8	10396.8	0
<b>Government</b>	24672	23164.1	23164.1	0
<b>Farm</b>	2646	1502.1	1502.1	0
<b>Total</b>	173044.7	210860.9	214135.3	3274.4

**Source: ABAG analysis using Bay Area REMI 1.7.8**

Sector adjustments for NC3 were as follows:

- a) Construction: REMI shows construction investment and jobs expanding far faster than historic trends. The high job growth comes from an overestimate of growth from 2013 to 2015, while the investment issue appears to be a weakness of the model. We applied actual BLS rates of growth for 2014 and 2015 to the 2013 BEA employment number given in REMI (this rate of growth is lower than the REMI projected rate of growth). From 2016 to 2019, the 2015 rate of growth is interpolated to reach the REMI estimated rate of growth by 2020. After 2020, employment grows at the REMI calculated rate, but from the new (lower) 2020 employment level. It is not possible to adjust residential and nonresidential investment in the model at the national level. ABAG's regional level adjustment is explained below.
- b) Information: REMI's national forecast for information is far less optimistic than most other forecasts and also underestimates recent growth. We built our adjustment on BLS 2012 to 2022

projections.<sup>6</sup> Specifically, we used measured BLS growth rates to adjust 2013, 2014 and 2015 numbers for subsectors publishing, internet, motion pictures and telecommunications (only 2014 and 2015). For subsequent years we used BLS 2012-2022 projected rates of growth (publishing, telecommunications), adjusted BLS 2012-2022 projected rates of growth (internet and other—decreased by two-thirds from 2021 to 2030, decreased forecast rates of growth by half from 2031 to 2040), or reverted back to the REMI rate (motion pictures). The relevant BLS projections are shown in Table A-2.

- c) Retail, Wholesale, Transportation and Warehousing: These sectors all dropped sharply over the 30-year period in REMI’s National Standard Control (NSC). We compared this to historic relations to factors such as population and manufacturing and adjusted the levels over time. To make these adjustments, we calculated log/log relationships with relevant factors (retail—population; wholesale—manufacturing and population; transportation and warehousing—population, manufacturing, and professional and scientific). We used these relationships to adjust growth rate either directly or in a tapered way (retail, wholesale) assuming effects of technological change. (See Table A-3 for regression results). While the distribution system for goods (wholesale, shipping, retail) is being affected by both automation and digitalization, the consumption of goods, and therefore the need to distribute it in some way to consumers continues, as will some level of employment demand. Furthermore, while traditional retail occupations may continue to shrink, the demand for places for social interaction, with some type of associated employment, may well continue. These sectors still add jobs much more slowly than the overall projection of growth.

This adjustment to the national control raised the employment forecast at the national level by about 1.6 percent compared to the REMI NSC. These minor adjustments allowed us to adjust the forecast to better reflect regional characteristics reflected in alternative forecasts while still accounting for the 2010 to 2015 surge in employment.

**Table A-2: Bureau of Labor Statistics 2012-2022 Employment Projections for Information Sectors (Thousands)**

	Actual	Forecast	Percent Change
Industry	2012	2022	2012 - 2022
<b>Publishing industries</b>	737.8	705.9	-0.4%
<b>Motion picture, video, and sound recording industries</b>	372.3	350.0	-0.6%
<b>Broadcasting (except internet)</b>	285.4	296.7	0.4%
<b>Telecommunications</b>	858.0	807.0	-0.6%
<b>Data processing, hosting, related services, and other information services</b>	424.1	452.8	0.7%

Source: ABAG from U.S. Bureau of Labor Statistics Economic Forecast , Detailed Industry, Table 2.7

<sup>6</sup> Bureau of Labor Statistics, Economic Forecast 2012 to 2022, BLS Detailed Industry, Table 2.7 Employment and Output by industry; <http://www.bls.gov/opub/mlr/2013/article/industry-employment-and-output-projections-to-2022.htm>.

	Dependent variables (log form)				
	retail employment	wholesale employment	air transportation	transit	warehousing
Independent variables (log form; t value in parentheses)					
Population	0.6180171 (6.19)	1.147926 (8.79)		1.949733 (21.44)	3.351744 (35.02)
manufacturing employment		0.3184065 (4.77)	0.9150349 (8.72)		
professional, technical and scientific emp.			0.5055651 (6.34)		
Adjusted R-Squared	0.6185	0.8358	0.7713	0.9523	0.9816

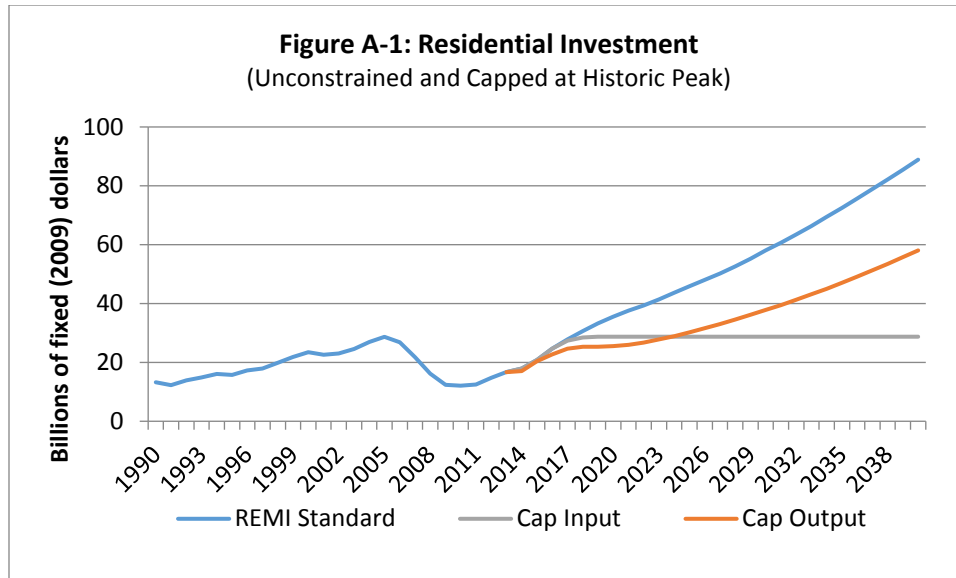
Source: ABAG analysis

### Adjustments to Regional Control

We created a new *regional* control based on our REMI NC3 national control with three additional adjustments (labeled NC3RC1). These include:

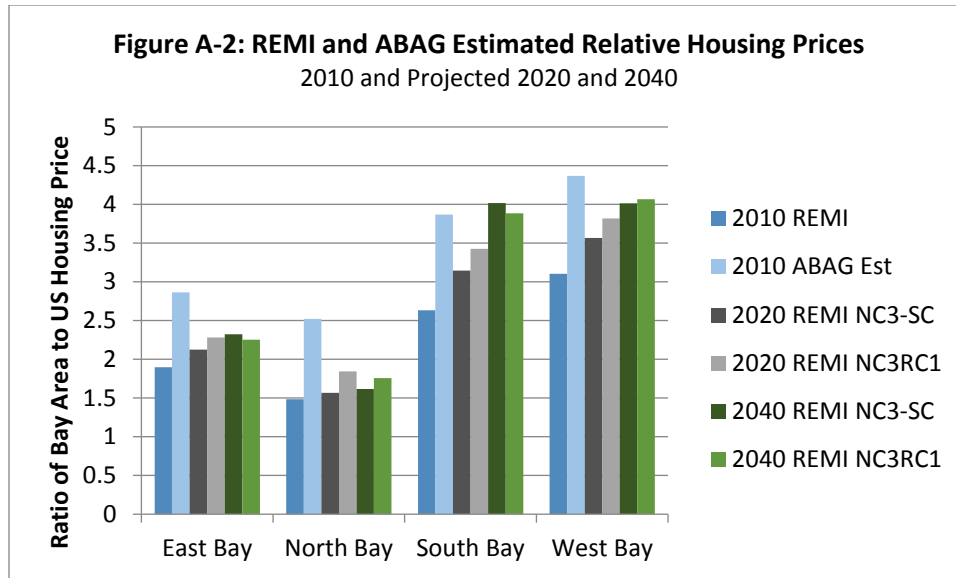
- 1) *A reduction of levels of residential and nonresidential investment* to temper the degree to which this expands. For those familiar with REMI, this is done by entering new investment numbers by subregion in the policy section of the regional control.<sup>7</sup> The new investment numbers were calculated to be no larger than the previous peak. Once entered into REMI, this does not actually cap investment to the previous level, but it does reduce the rate at which investment expands to a level more consistent with actual growth. Figure A-1 illustrates the relationship between the residential investment level in the standard regional control based on national control NC3, the input to the revised regional control for the final forecast (NC3RC1) and the output of the model for residential investment in NC3RC1. The relative positions of the lines also indicate the reason for the adjustment. Construction investment is generally a flow rather than a stock variable, and thus grows with the level of change, not the absolute level. Thus, the pace of growth in the standard control is much higher than would be expected from the economic growth observed.

<sup>7</sup> ABAG’s version of the REMI model has 4 subregions within the Bay Area—the East Bay (Alameda and Contra Costa counties), North Bay (Napa, Solano and Sonoma counties), South Bay (Santa Clara County) and West Bay (Marin, San Francisco, and San Mateo counties).



Source: ABAG from Bay Area REMI version 1.7.8, NC3 standard regional output and NC3RC1 capped input and output

- 2) *An adjustment to the ratio of Bay Area relative to national housing prices.* This policy variable has a bearing on economic migration levels as these are a function of the attractiveness of the Bay Area amenities and job opportunities, but tempered by the cost of housing. We found that REMI’s account of the cost of housing relative to the U.S. as a whole is substantially lower than what we calculate from other sources, leading to overly optimistic economic migration flows. Our adjustment was created using 2013 five-year American Community Survey (ACS) data for the U.S. and the MSAs relative to our analysis and the FHFA index adjusted to a 2011 base (to be consistent with the five-year ACS data). We used this data to create a series for price by MSA relative to the U.S. In looking back to 1975, it leaves only a small advantage for the Bay Area relative to the U.S., consistent with historic estimates. We then averaged the relative price from 2005 to 2014. We applied 50 percent of the difference between our calculations and the REMI levels to the forecast. As with construction investment, REMI still recalculates the relative price. The effect is insignificant by 2040 but raises prices midway through the forecast, relative to REMI’s unadjusted relative prices, as shown in Figure A-2.



Source: ABAG analysis from Census American Community Survey and Federal Housing Finance Agency data; REMI model output (NC3 unadjusted regional control, NC3RC1)

- 3) *An adjustment of employment levels in 2014 and 2015 to actual measured rate of growth by sector from BLS. For those familiar with REMI, we made this adjustment in the Policy section rather than in the Update section. This treats the higher employment levels as a short-term exogenous shock to which the model can then respond and adjust (e.g. short-term labor scarcity drives up costs and reduces demand). This is distinct from other possible treatments. We could also have treated the high recent growth as an accounting change through the update function, setting the baseline higher, which would have more long-term effects in an upwards direction (the magnitude of the long-term effect of this sort of adjustment is between 150,000 and 300,000 additional jobs by 2040). We chose this approach (exogenous rather than baseline accounting adjustment) because it is consistent with the region’s historic experience with the sectors that have driven the current surge, marked by not insignificant volatility.*

### Adjustments to BEA Employment Measure

After running the model, we then translate the Bureau of Economic Analysis<sup>8</sup> (BEA) measure of employment to an employment measure that combines Bureau of Labor Statistics (BLS) employment estimates with American Community Survey estimates of self-employment. These result in an average annual figure, rather than a count of all jobs that are offered at some time during the year. (Note that both definitions are different from the ABAG definition used prior to Projections 2013. Prior definitions were based on a count of one job per person, rather than jobs per workplace).

<sup>8</sup> The BEA measure accounts all jobs held at all firms by all individuals during a year (as well as self-employment), and thus is likely to double count individuals and even positions in a company (where there has been turnover in a position during the year or a shift in duties from one employee category to another). In contrast, BLS reports monthly employment which is then averaged for an annual count. The BEA count is related to the agency’s major responsibility of tracking income and output. The BLS estimate is more useful for regional planning purposes, because it is closer to identifying likely housing and travel demand. BLS does not report self-employment, so ABAG adds this estimate to the employment count using U.S. Bureau of the Census ACS data.

Table A-4 compares the 1.7.8 REMI control with the final forecast, using the BLS plus self-employment definition of employment. Table A-5 shows the ratios used to adjust BEA to BLS plus self-employment counts, estimated from an average of 2007, 2010 and 2013.

(Employment in Thousands)	2010	2040	2040	Percent Change 2010-2040	
	EDD+SE	REMI SC	Final Forecast	REMI SC	Final Forecast
<b>Agriculture &amp; Natural Resources</b>	25.1	24.8	24.4	-1.3%	-2.9%
<b>Construction</b>	165.7	411.0	313.4	148.0%	89.1%
<b>Manufacturing &amp; Wholesale</b>	428.5	395.7	408.3	-7.7%	-4.7%
<b>Retail</b>	324.8	353.4	398.2	8.8%	22.6%
<b>Transportation &amp; Utilities</b>	97.1	97.1	110.5	-0.1%	13.7%
<b>Information</b>	118.0	114.5	165.0	-2.9%	39.8%
<b>Financial &amp; Leasing</b>	194.9	234.1	234.5	20.1%	20.3%
<b>Professional &amp; Managerial Services</b>	625.2	1062.4	1093.4	69.9%	74.9%
<b>Health &amp; Educational Services</b>	502.7	883.3	887.6	75.7%	76.6%
<b>Arts, Recreation &amp; Other Services</b>	476.5	577.9	591.8	21.3%	24.2%
<b>Government</b>	452.2	474.9	471.3	5.0%	4.2%
<b>Total Jobs</b>	3410.9	4629.0	4698.4	35.7%	37.7%

Source: ABAG analysis from Bay Area REMI Model version 1.7.8, standard regional control and NC3RC1

BEA employment numbers are divided by the factors in Table A-5 to give estimates of the BLS (employment by place of work) plus self-employment equivalent.

Employment Sector	Adjustment Factor
<b>Agriculture &amp; Natural Resources</b>	1.402484
<b>Construction</b>	1.158725
<b>Manufacturing &amp; Wholesale</b>	1.084723
<b>Retail</b>	1.168494
<b>Transportation &amp; Utilities</b>	1.239593
<b>Information</b>	1.12953
<b>Financial &amp; Leasing</b>	2.377468
<b>Professional &amp; Managerial Services</b>	1.342899
<b>Health &amp; Educational Services</b>	1.091576
<b>Arts, Recreation &amp; Other Services</b>	1.374565
<b>Government</b>	1.035506

Source: ABAG analysis using BEA, BLS and American Community Survey data



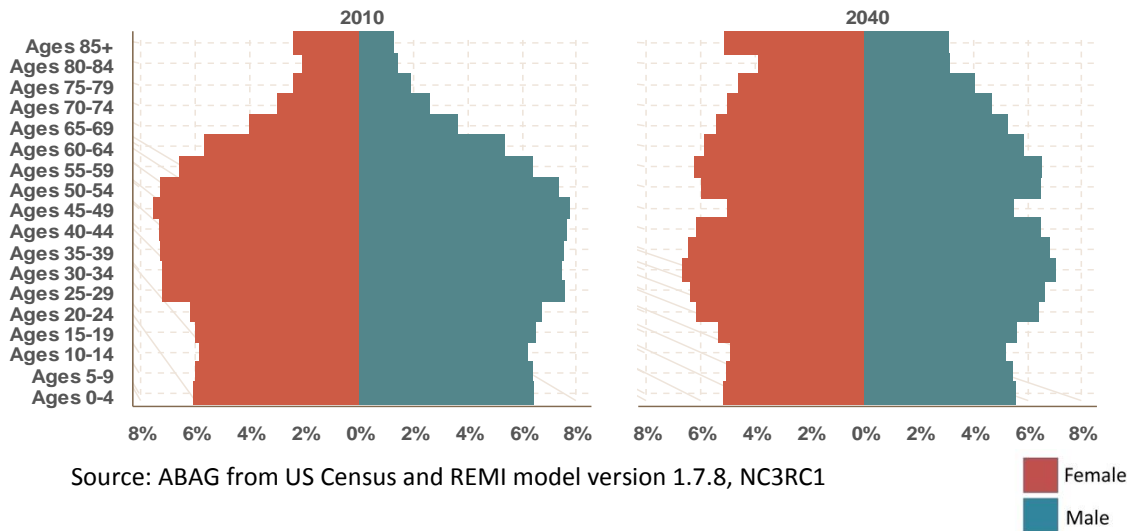
## Population

In developing the preliminary forecast, staff used two separate but similar population modeling approaches. The Pitkin-Myers population model for the Bay Area uses a cohort survival model, with careful attention to immigrant status, including generation since immigrating.<sup>9</sup> The REMI model uses a simpler cohort survival model, which also recognizes differences by ethnic group, but assumes once immigration has happened, the immigrant takes on the characteristics of the ethnic group. We compared the results of the different models in terms of age and ethnicity and found, especially for age categories, results were very similar. For consistency with the employment data, we used the REMI population forecast in both the preliminary and final forecast. Table A-6 compares results from four population projections, the REMI standard regional control, ABAG’s preliminary and final population projections, and the output of the Pitkin-Myers higher migration scenario. Figure A-3 shows population pyramids for 2010 and the 2040 population in the final forecast.

<b>Table A-6: Population Projections for Final Forecast and Alternative Forecasts</b>				
<b>Age Category</b>	2010	2040 Projections		
		Standard Control	Final Forecast	Pitkin-Myers In-Migration up 15%
<b>Ages 0-14</b>	1,320,200	1,532,900	1,499,300	1,524,500
<b>Ages 15-24</b>	909,800	1,160,900	1,126,200	1,054,900
<b>Ages 25-64</b>	4,051,500	4,908,200	4,779,000	4,786,500
<b>Ages 65+</b>	885,100	2,149,500	2,117,700	2,127,300
<b>Total</b>	7,166,700	9,751,400	9,522,300	9,493,100
<b>Share of Total</b>				
<b>Ages 0-14</b>	18.4%	15.7%	15.7%	16.1%
<b>Ages 15-24</b>	12.7%	11.9%	11.8%	11.1%
<b>Ages 25-64</b>	56.5%	50.3%	50.2%	50.4%
<b>Ages 65+</b>	12.4%	22.0%	22.2%	22.4%
<b>Source: ABAG analysis using Bay Area REMI model version 1.7.8, regional standard and NC3RC1, and Pitkin 2015</b>				

<sup>9</sup> See John Pitkin, *Summary and Analysis of Pitkin-Myers Generational Projections of the Population of the Bay Area to 2040*, Cambridge: June 30, 2015.

Figure A-3: Final Forecast Population Age Distributions, 2010 and 2040



Source: ABAG from US Census and REMI model version 1.7.8, NC3RC1

## Household Estimates

Household estimates are computed by applying headship rates, or the number of householders relative to the population calculated from the ACS to the REMI population output by age and ethnicity. The headship rate is applied to age/race/gender bins: two genders, four race / ethnic groups and 15 age groups, or a total of 120 distinct groups. Rates are pooled from ACS one-year Public Use Microdata Sample (PUMS) samples for the years 2006 to 2014, with an exponentially weighted smoothing average applied to avoid spikes in particular in the thinner slices of the PUMS sample.

While not adjusting headship rates secularly across the board, we did two specific rate adjustments:

- 1) We marginally reduced headship rates for Black and White, non-Hispanic households, age groups 25-34 and 65-74 by 5 percentage points to reflect expected changes in household sizes for those groups, due to changing cultural and financial conditions.
- 2) We reduced headship rates for Black and White, non-Hispanic households age groups 75+ by 10 percentage points to reflect expected increases in male survival rates.

We did not adjust headship rates for other ethnic groups related to increased "survival" of older age groups because headship rates were already so low for those ethnicities. Headship rates are summarized for the final forecast in Table A-7.

gender	Females				Males			
Race/ ethnicity	Black- NonHisp	Hispanic	Other- NonHisp	White- NonHisp	Black- NonHisp	Hispanic	Other- NonHisp	White- NonHisp
<b>Final Forecast Rates</b>								
<b>Age</b>								
<b>5-19</b>	0.0079	0.0041	0.0032	0.0063	0.0027	0.0038	0.0038	0.0040
<b>20-24</b>	0.2145	0.1410	0.1333	0.1854	0.1250	0.1051	0.1300	0.1652
<b>25-29</b>	0.4264	0.2917	0.2526	0.3297	0.1976	0.2525	0.3072	0.3195
<b>30-34</b>	0.4996	0.3938	0.3227	0.4241	0.3377	0.3705	0.5099	0.4652
<b>35-39</b>	0.6182	0.4092	0.3304	0.4864	0.4361	0.4514	0.5973	0.5432
<b>40-44</b>	0.6583	0.4296	0.3730	0.5316	0.4815	0.5020	0.6176	0.5557
<b>45-49</b>	0.6676	0.4290	0.3765	0.5238	0.5152	0.5207	0.6094	0.5897
<b>50-54</b>	0.6335	0.4319	0.3626	0.5296	0.5969	0.5389	0.6401	0.6182
<b>55-59</b>	0.6230	0.4450	0.3517	0.5317	0.5985	0.5511	0.6068	0.6427
<b>60-64</b>	0.6590	0.4260	0.3202	0.5450	0.6333	0.5852	0.6062	0.6817
<b>65-69</b>	0.6345	0.3922	0.3161	0.4986	0.6408	0.6314	0.5732	0.6829
<b>70-74</b>	0.6592	0.4589	0.2982	0.5161	0.6724	0.5735	0.5436	0.6862
<b>75-79</b>	0.6206	0.4298	0.3448	0.5016	0.6361	0.6103	0.5636	0.6629
<b>80-84</b>	0.6313	0.5203	0.4176	0.5485	0.6558	0.5400	0.5557	0.6491
<b>85+</b>	0.6118	0.4394	0.4458	0.6338	0.5327	0.5425	0.5632	0.6622

## Income Distribution

The income distribution analysis is designed to take into account structural characteristics of the region including demographic factors such as the age profile and ethnic mix, and economic factors such as the predominant industries and occupations in which people work, as well as the various sources of income (retirement income, public assistance income, wage and salary income). Other aspects of Bay Area regional forecasting rely on estimates of the distribution of income among four income bins originally defined using 1989 incomes and later updated using 1999 incomes. The categories, originally, were:

- 1) Below \$25,000 (1989 dollars, updated to \$30,000 for 1999 dollars)
- 2) Between \$25,000 and \$45,000 (1989 dollars, upper break point updated to \$60,000 for 1999)
- 3) Between \$45,000 and \$75,000 (1989 dollars, upper break point updated to \$100,000 for 1999),  
and
- 4) Above \$75,000 (1989 dollars, updated to \$100,000 for 1999).

As there is much uncertainty surrounding how income distributions change as a function of source uncertainty (i.e. how the population changes; how firms compensate their workers; how competitive are the local industries, among other things), the approach used estimates basic relationships between economic features and the share in a certain range of the income spectrum. All other things equal, for example, locations with a relatively large share of management occupations may be expected to have

more upper income households, while locations with a higher proportion receiving public assistance may conversely be expected to have more low-income households. To capture such relationships, ABAG specified four regression models (using American Community Survey and Census 2000 county-level data) on the relationship between demographic and economic variables and share of households in each of the four income quartiles defined above.

The results of these regressions are shown in Tables A-8 to A-11.

<b>Table A-8: Regression Results for Income Category 1 (Households below \$30,000, 1999 dollars)</b>				
	<b>params</b>	<b>pvals</b>	<b>std</b>	<b>test_stats</b>
<b>Adjusted R-Squared</b>	0	0	0	0.669211
<b>R-Squared</b>	0	0	0	0.672062
<b>Intercept</b>	0.741601	4.37E-41	0.052547	
<b>Share of population, White (not Hispanic)</b>	-0.17261	3.65E-39	0.012572	
<b>Wharton Residential Land Use Regulation Index</b>	-0.01799	1.35E-10	0.00277	
<b>Share of population, 65 and over</b>	0.997485	6.22E-50	0.063133	
<b>county housing price median relative to US</b>	-0.05317	1.32E-56	0.003127	
<b>more than 1 million people in MSA</b>	-0.04618	5.23E-27	0.004156	
<b>public assistance income, log</b>	0.040692	5.37E-38	0.003015	
<b>retirement income, log</b>	-0.04888	1.25E-33	0.003884	
<b>Share employed in nat resources, construction, and maintenance occupations</b>	0.427559	1.18E-22	0.042505	
<b>F Test</b>	235.6765	9.2E-217	0	

<b>Table A-9: Regression Results for Income Category 2 (Households \$30,000-\$59,999, 1999 dollars)</b>				
	<b>params</b>	<b>pvals</b>	<b>Std</b>	<b>test_stats</b>
<b>Adjusted R-Squared</b>	0	0	0	0.414723
<b>R-Squared</b>	0	0	0	0.419768
<b>Intercept</b>	0.530093	4.16E-89	0.023653	
<b>Share of population 16 and over in labor force</b>	0.090489	4.74E-05	0.022137	
<b>Share of population, Hispanic</b>	-0.05252	1E-13	0.00695	
<b>Wharton Residential Land Use Regulation Index</b>	-0.00256	0.055326	0.001336	
<b>Share of population, 25-64</b>	-0.35542	1.14E-14	0.045264	
<b>county housing price median relative to US</b>	-0.02176	9.58E-35	0.001697	
<b>County falls in Census Region 9</b>	0.013903	3.67E-06	0.002985	
<b>Share employed in education services</b>	-0.32121	1.62E-20	0.033779	
<b>Share employed in health care services</b>	-0.23159	2.98E-10	0.036355	
<b>F Test</b>	83.19669	2.2E-103	0	

<b>Table A-10: Regression Results for Income Category 3 (Households \$60,000-\$99,999, 1999 dollars)</b>				
	<b>params</b>	<b>pvals</b>	<b>Std</b>	<b>test_stats</b>
<b>Adjusted R-Squared</b>	0	0	0	0.647393
<b>R-Squared</b>	0	0	0	0.650053
<b>Intercept</b>	-1.08725	1.94E-61	0.060906	
<b>Share of population 16 and over in labor force</b>	0.290893	2.05E-35	0.022443	
<b>Share of population, Black (Not Hispanic)</b>	-0.03842	7.73E-06	0.008541	
<b>Wharton Residential Land Use Regulation Index</b>	0.007572	7.76E-08	0.001398	
<b>Share employed in health care services</b>	-0.32454	1.88E-17	0.037421	
<b>Share employed in professional and scientific services</b>	-0.49631	4.73E-26	0.045586	
<b>more than 1 million people in MSA</b>	0.019135	2.35E-18	0.002144	
<b>per capita income, log</b>	0.115644	3.85E-60	0.006561	
<b>F Test</b>	244.4039	4.9E-205	0	

<b>Table A-11: Regression Results for Income Category 4 (\$100,000 and over, 1999 dollars)</b>				
	<b>params</b>	<b>pvals</b>	<b>Std</b>	<b>test_stats</b>
<b>Adjusted R-Squared</b>	0	0	0	0.798193
<b>r2</b>	0	0	0	0.799035
<b>Intercept</b>	-1.2822	8.17E-55	0.078061	0
<b>county housing price median relative to US</b>	0.028745	1.37E-45	0.001943	0
<b>more than 1 million people in MSA</b>	0.016216	1.72E-16	0.00194	0
<b>per capita income, log</b>	0.134153	1.56E-58	0.007866	0
<b>Share employed in management occupations</b>	0.112038	1.4E-08	0.019613	0
<b>Share employed in services occupations</b>	-0.26406	1.23E-13	0.035204	0
<b>F Test</b>	948.6722	0	0	0

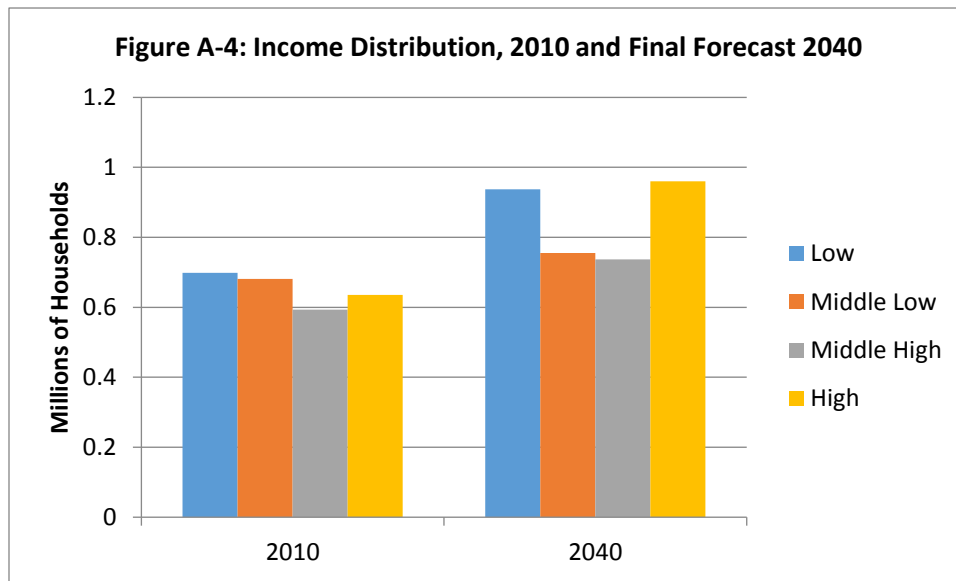
The parameters estimated in these regressions are applied to the subregional results of the REMI-based forecast to estimate future shares of households in each income group. (REMI results are estimated for four subregions within the Bay Area, including the East Bay—Alameda and Contra Costa counties, North Bay—Napa, Solano and Sonoma counties, South Bay—Santa Clara County, and West Bay—Marin, San Francisco and San Mateo Counties.)

Applying regression model coefficients to the projected REMI data for each subregion, we estimate a time series of future shares in each bin. In reaching these shares, we make a number of normalizing adjustments:

- 1) Predicted shares come from four separate regressions that are not constrained to fall in any particular range. The sum of the shares predicted by the four regressions is then normalized to 1.

- 2) These shares are indexed to the base year, with regression results expressed as changes over time according to the future state of the region as provided by REMI.
- 3) The indexed amounts are then applied to the base 2010 numbers to reach a growth in households in each income bin over time.

Figure A-4 compares the 2010 income distribution with the distribution in 2040 in the final forecast. The final forecast has somewhat higher growth in the highest income category, at the expense of growth in the two middle categories. The lowest income group grows slightly faster than the overall growth rate, and more quickly than either of the two middle groups, while the slowest growth is in the lower middle group. Note that in 2010, the upper income group may have been particularly depressed, because of lower levels of non-wage income in 2010 (e.g. capital gains) and because of depressed earnings related to incentive pay.



Source: ABAG analysis using projections from REMI model 1.7.8, NC3RC1.

## In-Commute and Employed Residents

To calculate the change in in-commute, ABAG estimates the change in employed residents and compares this to the projected growth of employment by place of work. REMI reports “residence adjusted employment” (RAE), which is the number of BEA defined jobs held by residents. This number is not a count of people holding jobs. To adjust this number to something closer to persons holding jobs, we divide the REMI projected RAE by the overall ratio of BEA to BLS plus self-employment jobs (BLS+SE) in the year, which we term  $RAE_{BLSSE}$ . Our net commute estimate for one year is the difference between BLS+SE and  $RAE_{BLSSE}$ . The change in commute, then, is the change in this estimate. Between 2010 and 2040, in our REMI based forecast, this difference increases by 53,000. (We also used an alternate calculation method, where we compared the projected labor force growth to employment growth, assuming a steady level of unemployment of around 5 to 5.5 percent during the forecast period. This

method gave more representative net commute numbers in the early years, but showed a *decrease* in net commuting over the 30-year period. We have chosen to include the higher number that comes from the RAE approach in estimating the Regional Housing Control Total, to ensure that the concern about considering the in-commute is met). Compared to the preliminary forecast, higher employment in the region led to a slightly higher increase in the net in-commute, from 33,000 in the preliminary forecast.

To translate the commute population into households, we referred to the American Community Survey to estimate workers per household. The American Community Survey five-year data set gives a representative range of households over a period from 2009 (when housing was less expensive, but employment was less available) through 2013 (when housing was becoming less available, but employment and incomes were higher). For that period, average number of employed workers per household for the region was 1.55, ranging from 1.37 in Marin to 1.64 in San Mateo. When all workers (employed and not employed) are included, the proportion drops to 1.42. If we assume the workers in-commuting from outside the region are likely to be below-median-income workers, then the ratio drops to 1.41. This is a slightly higher ratio than we used in the preliminary forecast, which was based on employees by place of work per household and included households with no workers and jobs whose workers may have commuted from outside. The number of in-commuting households is estimated to be 53,000 divided by 1.41, or 37,600, the number used in estimating the in-commute portion of the Regional Housing Control Total.

## Regional Housing Control Total

To compute the regional housing control total, we make a fairly simple calculation of housing associated with the projected number of households, and add to that the housing that would be associated with the net increase in the in-commute. We use a vacancy rate of 5 percent to translate the 3,389,000 households in 2040 (final forecast) to 3,567,000 housing units. Applying the same 5 percent vacancy rate to the 37,600 “in-commute” households, we then estimate a need for 39,600 housing units to satisfy the requirement that the Regional Housing Control Total include housing for the net increase in in-commuting. The Regional Housing Control Total becomes 3,606,600 housing units (the sum of 3,567,000 and 39,600), an increase of 822,600 units from 2010, or 767,000 from 2015. In comparison, the preliminary forecast projected 808,000 additional units compared to 2010, and Plan Bay Area 2013 estimated an addition of 660,000 units.